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THE PALE WESTERN CUTWORM (POROSAGROTIS ORTHOGONIA) (LEPID.).

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This insect was first known in 1876, near Fremont, Nebraska, where it was taken and named. It then disappeared from that vicinity, its disappearance caused, it has been surmised, by the severe grasshopper invasions of 1875 and 1876, and was unknown until 1911 when it was reported as doing much injury to small grains in Alberta, Canada. During the succeeding years it appears to have moved south, or, possibly, to have multiplied locally, and in 1919 it was doing noticeable damage to crops in eastern Montana and western North Dakota. Its chief injury was to wheat and corn but it also attacked rye, barley, oats and, to a limited extent, flax and millet, also potatoes.

Complaints from farmers who suffered from its ravages kept increasing and were so persistent that in 1921 a careful investigation of the pest was begun by the writer in co-operation with Dr. R. L. Webster, State Entomologist of North Dakota. A few observations had been made previous to 1921 but little had been learned of its habits or life history.

In the course of this study, which covered a period of several years, many fields were visited, a large series of observations was made and it is believed that at least a partial solution of the problem of control has been achieved. Much of the work was done in Golden Valley County, North Dakota, partly because of the heavy infestation in that locality and also because of the active and valuable co-operation of J. Clayton Russell, County Extension Agent, who assisted us in many ways.

Fields in the vicinity of Beach, in this county of North Dakota were alive with these cutworms in May, 1921 when the formal investigation began. In many places half a dozen or more could be uncovered by a single sweep of the hand through the surface soil. The majority, as a rule, were to be found close to the top of the ground, from one to two inches beneath the surface. The depth of their submergence appeared to vary more or less according to the amount of moisture in the soil. It was the general understanding that they followed the moisture line down, and this was probably the general habit. Still, it was always possible to find many worms lying in dry soil, close to the surface.

The belief has obtained currency among farmers, not only in North Dakota but in many other parts of the United States, that when the sun shines hot after a summer shower, cutworms will come to the surface and burst. Even well informed men countenance this absurdity and are with difficulty persuaded that the idea is ridiculous.

June 8th, 1921, a heavy shower of rain fell near Beach and Ray Hathaway, a reliable observer, reported that the worms came to the top by the hundreds. As soon as the rain ceased they disappeared in the earth. The rumor

spread that the rain had drowned the worms and the same story was repeated after other showers. When the soil is damp they are often found just beneath the surface, sometimes showing their location by a ridge thrown up, mole fashion, as they move about. This has been observed in fine soils, wind-blown and smooth.

One of the important facts that had to be established at the outset was regarding the feeding habits of the worms. If they came to the surface to feed, after the manner of most cutworms, it would be easy to poison them. If they remained constantly underground the problem was much more serious. To help settle this point we visited heavily infested fields after dark, using flashlights, to learn if any of the worms were feeding above ground. We were unable to find a single one that fed above the surface. This experiment was carried still farther by sowing poisoned bran on the surface of infested fields, both in the daytime and after dark. These fields were later carefully gone over to discover dead worms, if any. The surface soil was at the same time examined to learn if any worms had eaten the poison and then entered the earth to die. We were unable to find the least proof that any worms had eaten the poison.

On one occasion we smoothed a bit of ground and placed poisoned bran thereon with twenty or thirty cutworms. They at once accepted the bran, eating it readily. It appeared to take almost immediate effect. Those that did not eat made their way at once into the soil. If they were surface feeders we would surely have found dead worms where the poison had been spread. There is no doubt that they are strictly subterranean in their habits and as such cannot be controlled by ordinary methods.

The worms often do methodical work in a wheat field following the drill rows and making a clean sweep of every wheat plant. The worms in adjacent drill rows move toward the uneaten plants with equal speed and it is a common circumstance to find the wheat disappearing in an even line at right angles to the drill rows, making a square-ended wheatless area. These bare spots in wheat fields were about the first indication of the presence of the worms in this region and in numerous instances entire hundred-acre fields were swept almost clean of wheat plants.

Corn is often severely damaged and farmers have been obliged to replant corn two and three times and were not sure even then of a stand. One of the outstanding characteristics of this species is the ability to remain in a barren field for weeks if necessary, waiting for some growth to start on which they can feed. It is possible they may find some underground vegetation on which they can live during the plantless period since in several cases worms were found in some numbers in fields that had been plowed weeks before and the apparent lack of food had not forced them to migrate nor had caused their death. When such a field is sown or planted the worms are on hand to accept the growing crop as soon as it starts.

A small native vetch that is common in fields of the region furnishes food for the worms, the roots being cut below the surface. On several occasions, when other food plants were scarce, I have observed Russian thistles being killed by worms cutting the roots. Black mustard is sometimes a food plant. Curiously

enough they do not attack wild oats and fields have been found where every vestige of wheat has been destroyed, leaving a luxuriant growth of wild oats to deceive the farmer into thinking he had a fine stand of wheat.

A field near Sentinel Butte North Dakota was examined May 30, 1921, so recently planted to corn that none of the plants showed above the ground, most of it merely sprouted. Hill after hill in this field was located and found to be populated by cutworms that had in some manner discovered where the corn was lying. I was unable to find a single cutworm outside the hills of corn. By some mysterious sense they had been able to locate the corn grains and thus were on hand to attack the corn plants as they developed. Most of these larvae were quite small.

During the progress of this investigation it was learned that in some fields the worms might be nearly full grown while an adjoining field might have many smaller forms and only a few that were anywhere mature. No explanation has been adequate for this condition unless the character of the soil, varying amount of moisture or some such factor might hasten or retard the development of the eggs.

One of the most important questions to be definitely ascertained during the study was that of oviposition. It was known that the eggs must be deposited on or in the earth of the fields where the worms appeared later, but nothing certain was known about the places nor methods chosen by the moths for placing the eggs. A long and patient search was at last rewarded by finding eggs in some numbers in the tracks of horses in stubble fields where the weight of the animal had broken the slight crust formed by showers and reduced the foot print area to dust. Webster found three eggs in loose soil in half a day's search. The next day the writer took 55 eggs from a single horse track while Webster took nearly 100 eggs from another hoof mark not far away. From these and other facts it appears that the moths are attracted to any spot in a stubble field or weedy field where a horse or dog or person has pulverised the soil by walking across the fields while the moths were flying, or where the wheels of a wagon have crushed the surface. The eggs are placed in this dusty soil in early autumn and are covered slightly either by accident or on purpose. These will hatch, depending on the nature of the weather, in the fall or the following spring. It is believed that the majority of the eggs hatch in the spring, the tiny larvae feeding on the early spring vegetation. The larvae mature in July, enter the ground to the depth of three or four inches, make a cell where pupation takes place and from which the moth issues in late August or early September.

The moths are seldom attracted to light in large numbers but are to be found on flowers of golden rod, are seldom if ever seen on Grindelia or sunflowers. They are frequently very wary and are with difficulty approached. Again at times they will submit to almost unlimited annoyance before taking to wing. They are much more active on hot afternoons, remaining dormant on flowers during the forenoons and cooler parts of the day. Their flight is swift, erratic and sustained usually for quite a distance.

Regarding their food other than golden rod nectar, little is known. September 8, 1921, a number of moths were observed feeding on the tips of some corn ears that had been recently eaten by grasshoppers. The proboscis would

be thrust down between the rows of corn on the cob and the feeding was prolonged and evidently satisfactory. On another occasion a moth was observed to be sucking the juice from a broken stalk of corn.

The matter of control is of course the problem with this, as with every other, pest. A good many interesting facts have been gathered during this investigation that bear on this question.

Rod weeders are used to some extent in this region where the moths abound, and these machines, by keeping the soil free from weeds and the surface more or less pulverized, would seem to afford an ideal condition for oviposition. Such fields are usually well covered by lumps of earth by this process of cultivation which prevents the soil from blowing and these clods may serve to repel the moths for rarely, if ever, is such a field infested in the year following the fallowing. Again, land that is kept clean of weeds by cultivating corn or potatoes is rarely infested the next year.

Rye stubble, for some reason, appears to be free from oviposition. This fact seems to be well established. One of the most remarkable instances that prove this was observed on the farm of Mr. Vasey, six miles S.E. of Mott in Hettinger county, North Dakota. Sixty acres of corn had been planted on this farm in May 1922, half of it on wheat stubble, the other half on rye stubble. All this stubble land had been plowed at the same time and had received the same treatment in every respect. When the writer visited this field late in June it presented a most remarkable aspect. Where the wheat stubble had been the corn was almost totally destroyed, large areas of this part of the field being entirely bare. On the rye ground, directly joining the wheat, hardly a plant was missing, the rows being well defined and perfect. The line of demarcation between the two halves of the field was as distinct as could be imagined. The corn had all been planted at the same time.

One control method that has been advocated by some farmers is the burning over of infested fields in the fall or early spring. Reports as to the effectiveness of this measure bring many conflicting statements, but only a few recommend it. A substantial growth of stubble or weeds is obviously necessary for success and even then it is doubtful if a fire sweeping across a field will produce any appreciable amount of heat except in the air. If eggs have been placed in a field the heat may destroy them but it is difficult to prove that eggs were there when the fire is applied. In the early spring when the eggs are hatching and the young larvae are on or near the surface the fire may be effective. But again, it is not easy to prove that the larvae were present. To be sure that burning was a success one would have to prove conclusively that the field was infested and that, at that time of year, is difficult.

June 8 1921, Ray Hathaway, a farmer a mile north of Beach, N.D., cleared a weedy field, raking the rubbish, mostly Russian thistles, into heavy windrows. These windrows were burned and, as is well known, these thistles generate an intense heat while burning. In spite of this fierce heat cutworms an inch below the surface, directly below the windrows, were living and unharmed when the hot ashes were raked away. It would be impossible, under ordinary circumstances, to produce more heat than this fire generated.

The result of the investigations during the years 1921 to 1925 was quite conclusive in proving that clean farming would do much to lessen the numbers of these cutworms. Also that a proper system of rotation, that has not yet been fully worked out, would probably prevent oviposition to a large extent. Rotation of course presupposes enough live stock to dispose of the products of crops other than small grain.

The natural control of this pest consists of three sorts, birds, predatory insects and parasites. Among the birds of this region the horned lark, *Otocoris alpestris*, is the most active enemy of the cutworm. A wheat field near Mott, N.D. was dotted with small mounds of earth thrown up by this bird while digging out the cutworms. On nearly every mound was the vicera of the unearthed worm, the outer skin having been evidently stripped off and eaten. The birds were still busy in this field and the process of digging out and eating the worms was repeatedly observed.

It is possible that the lark bunting, *Calamospiza bicolor*, may also eat the worm but it has not yet been ascertained if this bird is insectivorous or a seed eater. It is constantly in the fields but no opportunity offered to learn the food habits.

The most effective predatory insect is the large ground beetle, *Calosoma*. Both larvae and adults prey on the cutworms and are very active in pursuit. Several species of this beetle are present in the fields. In 1921 the beetles were very rare but by June 1922 both larvae and adults were becoming numerous. The adult would rarely attack a cutworm in the presence of an observer but the larvae are always ready to tackle any sort and size of cutworm. As many as three and four cutworms have been given to a Calosoma larva, one after the other, and the valiant larva would kill them as fast as presented. Many times I have seen the cutworms emerging from the ground with a Calosoma larva in hot pursuit or even fastened to the body of its prey and when once these larvae take hold they seldom let go, regardless of the size of the victim or of its contortions. In the opinion of the writer the decrease in the numbers of the cutworms since 1924 may be credited to the increase of these beetles and their young.

Several species of parasitic flies attack these worms but it is doubtful if these are effective in checking the numbers of the pests. One species of parasitic fly lays its eggs on the blades and lower body of wheat plants and these eggs when swallowed by the cutworms with the plant tissue hatch inside the worms and ultimately kill them. But as far as our observations went in North Dakota only a small percentage of the worms were destroyed in this manner.

Cutworms have in 1926 and 1927 decreased markedly in numbers where they swarmed a few years ago but in a few fields they are still present in sufficient numbers to be a potential menace to that region in case conditions, not by any means understood as yet, should become favorable for their multiplication. The decrease in the numbers of predacious and parasitic enemies, weather that favored the preservation of the eggs in the field, the following of wheat with wheat year after year regardless of the presence of the cutworms and other like factors would without doubt result in an injurious increase of the Pale Western Cutworm where at present it is temporarily in eclipse.

ADDITIONAL TRANSITION FORMS (LEPID., RHOPALOCERA).

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(Plates A & B)

NOTICE OF PRINTER'S ERROR. Description No. 15 in the December, 1927 issue should read—*Lycaena helloides* (Bdv.), tr. f. *sternitzkyi*, instead of *Lycaena thoe* (Guer.), tr. f. *sternitzkyi*. Author's manuscript, as submitted, stands correct and illustration No. 15 is obviously not a *thoe* (Guer.).

The butterfly transition forms herein described follow that method of classification outlined in the November, 1927, Entom. News, (Phila.). The half-tone illustrations of these specimens vary in size, a reference to their wing expanse as given in the text is advisable.

Papilio zelicaon Luc., tr. f. **mcdunnoughi** f. tr. nov.

Submarginal row of yellow spots on upper and under sides of both primaries and secondaries shaded over and obscured with black, especially on secondaries. Blue scales unchanged. Figs. 1b & 1bb illustrates a typical ♂ *zelicaon*.

Classification: transition form; melanism—the final degree is unknown, probably near final?

Data: Holotype ♂ (figs. 1 & 1a), expanse 67 mm.; Waterton Lakes, Alta., Can. (McDunnough), June 29, 1923; in Nat. Coll., Ottawa. Two paratypes; altogether similar, as follows: 1st. male, Big Horn Mts., Wym., Aug. 19, '27, in John Garth coll., Long Beach, Calif. 2nd. male, Colorado (Bruce), no date, in Strecker coll., Field Mus., Chicago, Ill. Named after Dr. J. McDunnough of Ottawa.

Note: Through the courtesy of Dr. Bang-Haas of Berlin, I have obtained type illustrations of the following which are listed by Barnes & Benj., to wit:—*Impunctata* Fischer is not a tr. f., but a specimen whose general yellow designs expand generally at the expense and to the restriction of the black, even to a restriction of the usually found black apical spot. The type is a "variation within the limits of the typical species itself" and therefore a synonym of *zelicaon*. *Melanotaenia* Fischer is another example of European naming without basic reason. This type specimen lacks blue scaling on upper side, but has it beneath. In any series of *zelicaon* the amount of scaling varies, it represents another case of "legitimate variation within the species range." *Formosa* Fischer "happens" to deserve recognition because it is a case of melanifusism, having the submarginal band of black elongated inwardly a little after the fashion of *P. ajax calverleyi* Grt. The original descriptions of the above Fischer specimens are very meager and no type locality given with text. Check list revision as follows—

zelicaon *Luc.*
zolicaon Bdv.
californica Men.
coloro Wright.
impunctata Fischer.
melanotaenia Fischer.
tr. f. formosa *Fischer.*
tr. f. mcdunnoughi *Gunder.*

Eurymus philodice (Godt.), tr. f. **raritus** f. tr. nov.

On the upper side lacking the usual marginal black border on secondaries, while on the primaries, this is confined to the apical region only, otherwise typically yellow. Under sides as usual.

Classification: transition form; immaculism—probably near a final phase.

Data: Holotype ♀ (figs. 2 & 2a), expanse 44 mm.; Scranton, Pa. (bred by Max Rothke), July 8, 1927. In Author's coll.

Note: In the illustration the veins stand out too prominently due to a photographic shadow. This specimen superficially resembles a ♀ *interior* Scud., but it is truly a retrogressive *philodice* Godt.

Dione vanillae (L.), form norm. **incarnata** Riley, tr. f. **margineapertus**

Typical *incarnata* Riley, as shown by fig. 3a, has on upper side secondaries a black marginal band containing a row of large ground-color spots. In this tr. f., this row of spots is broken on the inner side joining with the brown ground color and leaving merely a serrated-inward black band at outer margin. The under side silver spots seem unaffected by the upper side change.

Classification: transition form; immaculism—fairly well advanced.

Data: Holotype ♂ (fig. 3), expanse 50 mm.; Los Angeles (Schrader), Mar. 29, 1927. In Author's coll. Two paratypes of similar immaculism also in Author's collection.

Brenthis myrina (Cram.), tr. f. **nivea** f. tr. nov.

The ground color is white on both upper and under sides instead of the usual yellow-brown. No maculation change. Not faded or discolored. Fig. 4a shows a typical *myrina* for color comparison.

Classification: transition form; albinism—final change.

Data: Holotype ♂ (fig. 4), expanse 40 mm.; Staten Island, N.Y. (O. Fulda), May 28, 1900. In Author's coll.

Brenthis chariclea (Schneid), race **oenone** (Scud.), tr. f. **labradorensis** f. trr. nov.

Upper side. Primaries; all maculation entirely shaded over with the brown-black color, cell area a trifle darker. Secondaries; also fogged over obscuring design except that of some detail nearer anal angle. Fig. 5b shows a typical upper side, a Hopedale, Labr. specimen.

Under side. Primaries; discal and basal area markings fused together making a nearly solid darker colored area, limbal markings indistinct. Secondaries; discal area black design slightly extended inward, otherwise as usual.

Classification: transition form; melanifusism—nearly a final degree.

Data: Holotype ♂ (figs. 5 & 5a), expanse 37 mm.; Labrador, no date. In the Barnes coll., Decatur, Ill. and received through the purchase of the Oberthur American material.

Note: It is very doubtful whether *boisduvalii* Dup. occurs in North America. I credit this tr. f. to *oenone* Scudder.

Euphydryas colon (Edw.), tr. f. **mcdunnoughi** f. tr. nov.

Upper side. Entirely black with red marginal border spots remaining as in typical specimens, however a very few faint white scales remain on primaries indicating position of former submarginal row of white spots. Fig. 6b shows the Edward's male type.

Under side. All red maculation remains as before and the usual white becomes consistently red in place with no alteration in design, division of red and black clearly defined. Fig. 6bb shows the under side of fig. 6b.

Classification: **transition form**; melanifusism—final phase.

Data: Holotype ♂ (fig. 6, upper side, fig. 6a under side), expanse 45 mm.; Corvallis, Oregon (Buckell), June 20, 1925. In National Collection, Ottawa, Canada. Named in honor of Dr. J. McDunnough.

Note: *colon* Edw. is really a northern geographical race of *chalcedona* D. & H. A paper upon the revision of the *Euphydryas* group is now in press elsewhere.

Euphydryas rubicunda (Hy. Edw.), tr. f. **cottlei** f. tr. nov.

Upper side. Primaries; discal and basal areas black except for two red cell spots; submarginal row of minute white spots obsolete; next inner row of white spots a trifle larger and slightly fused on outward side; red margin as usual. Secondaries; all red unchanged; minute submarginal white spots become a black band practically; spots through basal area tend to become obscured with black. Fig. 7b represents the Hy. Edw. type upper side.

Under side. Primaries changed in accordance with upper side, while the secondaries are about typical though slightly blurred in appearance. Fig. 7bb is the under side of Fig. 7b.

Classification: transition form; melanifusism—semi-final grade.

Data: Holotype ♂ (figs. 7 & 7a), expanse 36 mm.; Lower Yosemite Valley, Calif. (Cottle), June, 1909. In Author's coll. through courtesy of James Cottle of San Francisco, our pioneer lepidopterist, after whom I am pleased to name this transition form.

Euphydryas taylori (Edw.), tr. f. **barnesi** f. tr. nov.

Upper side. Primaries; marginal red border and the two red cell spots as usual; all other design and spots become black except larger submarginal row of white spots which remain in former position though enlarged somewhat. Secondaries; red and black only, the former white rows becoming black in addition to the already existing black and red. Fig. 8b, a typical male.

Under side. Change in primaries very similar to the upper side; secondaries red and black like upper side though a streak of white runs through discal area marking position of row of bar spots in typical specimens. Fig. 8bb shows under side of fig. 8b.

Classification: transition form; melanifusism—three-quarters final. (the allotype ♀ is final; not illustrated).

Data: Holotype ♂ (figs. 8 & 8a), expanse 37 mm.; Victoria, B.C., Can. (Crocker), May 9, 1910. Allotype ♀, expanse 38 mm.; all black and red, a final phase, Victoria, B.C., Can. (Crocker), May 4, 1910. One paratype ♂, like described holotype with same date & place. All in Barnes coll., Decatur, Ill. and named in honor of Dr. Barnes of that city.

Euphydryas maria (Skin.), tr. f. **skinneri** f. tr. nov.

All rows of white spotting on both upper and under sides radiating outward and tending to join together with the disappearance of the transverse designs much after the fashion of *Euphy. chalcedona fusimacula* Barnes and others. Figs. 9b & 9bb illustrate Skinner's male type.

Classification: transition form; albifusism—well developed, but not final.

Data: Holotype ♂ (figs. 9 & 9a), expanse 36 mm.; Eureka, Utah (Spalding), May 27, 1920. In the Wm. Barnes coll.

Euphydryas maria (Skin.), tr. f. **spaldingi** f. tr. nov.

Figures 10 & 10a illustrate this case of melanifusism in comparison with figures 9 & 9a which is an instance of albifusism in the same species. Note the under side secondaries for example.

Classification: transition form; melanifusism—well developed, but not final.

Data: Holotype ♀ (figs. 10 & 10a), expanse 40 mm.; Stockton, Utah (Spalding), May 23, 1924. In Barnes coll., Decatur, Ill. and named after Tom Spalding of Dividend, Utah who has supplied this species to most American collections.

Note: Another specimen in the Barnes coll. labelled—Eureka, V|20|21, has the primaries well developed black.

Euphydryas carmentis B. and Benj., tr. f. **charlotteae** f. tr. nov.

Upper side. In addition to the existing black maculation, all the cream white markings become the same black, leaving the wings in only two colors, viz: black and red-brown. There seems to be no general design change, except a slight fusion about the cell. The right primary is slightly underdeveloped as compared to the left, it having a trace of the former larger row of cream spots.

Under side. As illustrated, the cell and apical area of primaries have acquired a melanic tinge, with only the second lunate submarginal row showing any cream color. The secondaries show a general replacement of the lunate yellow designs by black, excepting the row of bar-shaped spots through discal area which retain their shape and color. The basal area cream spots also show a reaction to black. Figs. 11b and 11bb picture a *carmentis* ♀ paratype.

Classification: transition form; melanifusism—practically final degree.

Data: Holotype ♀ (figs. 11 & 11a), expanse 42 mm.; Pagosa Sprs., Archuleta Co., Colorado. June 24-30. Named in honor of Mrs. Wm. (Charlotte) Barnes whose hospitality to all visiting lepidopterists makes their sojourn in Decatur, Ill. an added pleasure.

Melitaea (Lemonias) **palla** (Bdv)., race **whitneyi** (Behr), tr. f. **vanduzeei** f. tr. nov.

Upper side. Deep red and black only, no lighter shades. The marginal row of red spots without the usual thin black line. A submarginal row of red spots not reaching the costal or inner margins, then solid black through discal and basal areas. A slight red crescent extremity of cell. I regret that fig. 12a is so poor regarding showing of colors. Fig. 12b is a typical *whitneyi*.

Under side. As on upper side, pure dark red and black, except remains of some cream scales in a row well in and nearer costal margin on primaries with secondaries showing the series of usually found, though fused, cream spots centre discal area.

Classifications transition form; melanifusism—upper side final at least.

Data: Holotype ♂ (figs. 12a upper side & 12 under side), expanse 36 mm.; Portola, Calif. (Newcomer), Apr. 25, 1908. In Acad. Nat. Science coll., San Francisco. Named after Dr. E. P. Van Duzee of the Academy.

Melitaea (Lemonias) **hoffmanni** (Behr), tr. f. **hollandae** f. tr. nov.

I have examined the type of Wright's tr. f. *abnorma* which is shown on his pl. XX, figs. 183 & 183b. It is a case of albifusism. This newly described specimen is shown in Holland's butterfly-book, pl. XXII, fig. 14 and it is an example of melanifusism. Note the upper sides of these specimens as they are shown in color, comparing the light fusion of one with the dark fusion of the other. Figs. 13b & 13bb on my plate illustrates typical *hoffmanni* Behr.

Classification: transition form; melanifusism—almost final degree.

Data: Holotype ♀ (figs. 13 & 13a), expanse 40 mm.; Summit, Calif., July 24. In Holland's coll., Carnegie Mus., Pittsburgh, Pa. Named in honor of Mrs. W. J. Holland in remembrance of that pleasant evening and dinner party given to Mrs. Gunder and myself when in Pittsburgh in the fall of 1926.

Melitaea (Lemonias) **cyneas** (G. and S.), tr. f. **infrequens** f. tr. nov.

Upper side. Submarginal row of white spots on both primaries and secondaries as usual with all others through discal area obsolete. Fig. 14 fails to show several dashes of red opposite cell on primaries underlying these spots. Fig. 14b represents a typical *cyneas* upper side.

Under side. Primaries; a single submarginal row of white spots, those at apex being elongated outward to margin and squarish; balance of wing without spotting and clear ground color. Secondaries; band of black at outer margin occupying space between it and row of black circled white spots which are somewhat more heavily outlined. Rest of wing unchanged. Fig. 14bb shows a typical *cyneas* under side. This tr. f. is very similar to species *wrighti* Edw., tr. f. *carolynae* Gun. which is illustrated in color in Ent. News, pl. 1. Jan. 1926.

Classification: transition form; melanfusism—as final as those similar.

Data: Holotype ♂, (figs. 14 & 14a), expanse 37 mm.; Huachuca Mts., Ariz., Aug. 8-15. In Wm. Barnes coll. at Decatur, Ill.

Melitaea (Lemonias) **theona** (Men.), race **thekla** (Edw.), tr. f. **benjamini f.** tr. nov.

Upper side. Primaries; black has taken the place of the cream marks and spots with regular black as usual, except for remains of some cream spots in position of regular larger row usually found. Secondaries; here black is also found in place of the cream colored rows of spots. Fig. 15b shows a regular specimen of race *thekla* Edw.

Under side. Showing a series of elongated cream colored flashes in apical opposite cell with secondaries having a complete row of minute round spots center limbal area, otherwise black as on upper side.

Classification: transition form; melanifusism—nearly final degree.

Data: Holotype ♂ (figs. 15 & 15a), expanse 33 mm.; So. Arizona (Poling), July 15-30. In Barnes coll., Decatur, Ill. Named after Mr. F. H. Benjamin.

Phyciodes nycteis (D. and H.), tr. f. **lacteus** f. tr. nov.

Similar to *Brenthis myrina nivea* Gun. described above in having the ground color on both surfaces a natural white (or whitish-cream) instead of the usual brown. No maculation change.

Classification: transition form; albinism.

Data: Holotype ♂ (figs. 16 & 16a), expanse 40 mm.; nr. St. Louis, Mo. (Knetzge), July 10, 1908. In Author's coll.

Note: tr. f. *milburni* Rummel is an example of albifusism (Bull. Brook. Ent. Soc., Dec., 1926).

Phyciodes gorgone (Hbn.), tr. f. **nox** f. tr. nov.

Upper side. Primaries solid black except for two bar-shaped brown spots in cell. Fig 17b shows a typical upper side *gorgone* for comparison.

Under side. Primaries; having a rather large transverse brown spot running through center limbal area; base and cell areas brown in sharp contrast to other black areas. Secondaries; their designs seem heavier and are slightly blurred over with brownish shading. Fig. 17bb is a regular under side.

Classification: transition form; melanifusism—final phase except for under side secondaries.

Data: Holotype ♂ (figs. 17 & 17a), expanse 29 mm.; Brownsville, Texas (Dorner), April, 1911. Allotype ♀ (not figured), expanse 31 mm.; Kerrville, Texas. Description similar, but not so far advanced for melanifusism because of having a submarginal row of spots on both wings, upper side. Above types in Barnes coll. Decatur, Ill.

Phyciodes tharos (Dru.), tr. f. **dyari** f. tr. nov.

Fig. 18, under side, so well illustrates this splendid example of melanifusism that description seems unnecessary. Note full development of all black designs. The upper side (not shown) corresponds in change. Both *packardii* (Saund.) and *reaghi* (Reiff) are tr. fs. which show albifusism. The latter falls as a synonym under the former because Saunders' specimen was named first.

Classification: transition form; melanifusism—final phase.

Data: Holotype ♂ (fig. 18 under side), expanse 32 mm.; Webster, N. H. In the coll. of the U. S. Nat. Museum, Washington, D. C. and named after Dr. H. G. Dyar who has accorded me so many favors and much personal information.

Phyciodes campestris (Behr), tr. f. **mcdunnoughi** f. tr. nov.

Upper side. Primaries; a dark marginal border band, followed by an area of variegated yellow-brown through limbal and discal areas to base which has two dark edged cell spots. Secondaries; marginal band repeated, followed by a clouded row of usual eye-circled spots in yellow-brown; dark from there on into basal area with cell marks in contrast.

Under side. Primaries; apical areas yellow color, balance of wing a yellow-brown with costal portion slightly darker and showing arrow-pointed white flashes nearer apex. Secondaries; all designs indistinct and yellowish. Figs. 19b & 19bb illustrate a typical *campestris*.

Classification: transition form; albifusism—partly developed.

Data: Holotype ♀ (figs. 19 & 19a), expanse 35 mm.; Olds ?, (T.N.W.), no date. In National Collection, Ottawa, Ont., Can. Named after Dr. J. McDunnough of Ottawa.

Chlosyne **lacinia** (Gey.), race **rufescens** (Edw.), tr. f. **inghami** f. tr. nov.

Upper side. Primaries: the usually appearing four elongated white spots extending down from the costal margin absent or practically covered with black ground color scales; the minute submarginal row of white spots conspicuously enlarged and elongated into white flares, especially opposite cell, outwardly. Secondaries as usual and having typical row of red-brown discal bars which I suppose represent the name *rufescens* Edw.

Under side. All white spots and dots in apical area of primaries tending to fuse together, otherwise as usual. Secondaries unchanged. Figs. 20b & 20bb reproduce a typical specimen.

Classification: transition form; for the time being I place this example under melanifusism because of the extention of black through the cell areas of primaries.

Data: Holotype ♂ (figs. 20 & 20a), expanse 42 mm.; Mesa, Ariz. (Ingham), Aug. 23, 1927. In Author's coll. and named after Mr. Chas. Ingham of Los Angeles.

Note: This species in So. Calif. and Arizona shows considerable variation regardless of locality. I do not believe all the racial names have much meaning as such. More revisional work needs to be done in this group.

Plebeius saepiolus (Bdv.), race **hilda** (Grin.), tr. f. **garthi** f. tr. nov.

Upper side as in typical specimens. On the under sides, the minute marginal spots are absent with the two submarginal rows of black spots on both wings joined together through their interspaces forming a complete series of bar-shaped maculations. Crescent cell spots and basal secondary spots unchanged. Fig. 21a is a typical ♀ *hilda* Grin.

Classification: transition form; melanifusism—final degree.

Data: Holotype ♀ (fig. 21), expanse 25 mm.; Tahquitz Valley, Riv. Co., Calif. (Garth), June 27, 1927. Named after Mr. John Garth, Long Beach, Calif.

REVISION OF THE GENUS ODONTAEUS, DEJ. (SCARABAEIDAE, COLEOPTERA).

BY J. B. WALLIS,
Winnipeg, Man.

(Continued from page 156)

Odontaeus filicornis Say.

Jour. Acad. Nat. Sci., Philadelphia, Vol. 3, 1823.

Original Description.

"*Geotrupes filicornis.* Rufous; thorax tridentate; clypeus with an elongate horn. Inhabits Upper Missouri.

Body pale brownish-rufous; clypeus, anterior and lateral margins punctured, entire; horn elongated, linear, slightly curved and compressed, longer than the greatest width of the head; thorax unequal; three tubercles, placed in a transverse series, the exterior ones compressed and longitudinal, intermediate transverse subemarginate; an indented line behind the middle tubercle, and a concavity each side; scutel triangular; elytra with punctured striae. Length one fourth of an inch.

I obtained it near the Council Bluff on the Missouri. Mr. T. Nuttall obtained specimens on the Arkansas. Belongs to the Genus *Odontaeus* Megerle."

It is impossible from the above description to know what species Say had before him, but the description of the exterior thoracic tubercles as being "compressed and longitudinal" seems at least to eliminate the species in which these "tubercles" are conical horns. It may be noted that Say does not mention the horn as being movable. This character is attributed to it by Dr. Horn—(Trans. Am. Ent. Soc. Vol. III) and, in addition, he raises the length of the insect to .34 inch. *Falli* is the only other species except *thoracicornis* which comes very

near the territory assigned to *filicornis* by Say, but *falli* is black when mature and the probability that Say would be so unfortunate as to take all immature specimens is extremely small. Further, the most southerly locality so far known for *falli* is Volga, S.D., considerably further north than Council Bluffs. Eliminating *falli* and *thoracicornis* the only species from Say's locality is one chiefly represented by material from Medora, Kansas, almost exactly midway between Say's stations. As a specimen of this species is known from Minnesota, and Say's description, even as to size fits the Kansas species it has been determined as *filicornis* Say and a specimen labelled as *neoholotype*.

As *filicornis* is very close in all respects to an eastern species next to be considered, a detailed description of the neoholotype is given.

Neoholotype: *Shape and Size*: Oblong- oval. Length: 7.14 mm. Width: 4.76 mm.

Colour: Moderately dark red-brown above, below a little lighter, the legs approximately the same colour throughout. Antennal club the same colour as the front femora.

Clypeus: Rounded at sides, feebly emarginate at middle, the angle formed by the meeting of the two halves of the strong acute clypeal margin very obtuse. Surfact not punctured but broken up into large, rather deep depressions by irregularly intersecting rugosities. Medial carina does not continue anterior margin backwards but is considerably lower than it at the anterior margin, much stronger and acute medially, three-quarters depth of clypeus.

Thorax: Anterior angles less than right—scarcely rounded. Apex rather abruptly and deeply sinuate within. Apical width very nearly the greatest width of head, the apical angles almost meeting the free margin of the head at its termination at the eye. Sides moderately rapidly diverging anteriorly, less rapidly converging from about middle of length to base. Basal angles obtuse, not widely rounded. Sinuation of base within the basal angles quite moderate. Punctured anteriorly, laterally and in the depressions rather closely with large, rather evenly placed, coarse shallow punctures in the exact centre of the bottom of most of which is a punctule. A sparse micro-punctulation visible throughout. Medial elevation moderately well forward, the tubercles at about apical five-eighths partly closed in front by an emarginate ridge joining the darker tubercles, wide, the groove rather deep and wide, convex longitudinally and laterally, somewhat densely but irregularly punctured. Lateral foveae deep, especially near lateral ridge, well separated from the base but in great part caudad of the medial tubercle. Lateral ridges strong, acute, rounded, highest at about middle of length, but sloping more gradually basally and running well forward of the medial tubercle.

Elytra: Striae feebly impressed, sutural a little more so basally. Strial punctures large, round, moderately deep, separated by from a little less to a little more than their own diameters, minute punctules rather evident, eleventh striae poorly developed, fourteenth but little curved, its basal punctures coalescent with the supernumerary punctures in the gutter.

Legs: The hind tarsal ultimate joint and its claws are respectively longer than those in the next species. (See Fig. 17a, 17b, 18a, 18b.).

Genitalia: Outer lobes pale yellow, medial lobe slightly more reddish, most distinctly so on inner side of hook at base; moderately long, and linear, evenly curved. (See Fig. 7.).

Neoallotype: *Shape and Size*: Oblong-oval, a little narrower than the male. Length: 7.21 mm. Width: 4.62 mm.

Colour: As in Neoholotype.

Clypeus: As in Neoholotype except that as usual in the females the depth is somewhat greater, the anterior margin, probably owing to wear, less pronounced, with the medial carina consequently more nearly continuing the margin backward, still, however, somewhat lower; a number of scattered small punctules on the rugosities and in the interstices.

Thorax: Anterior angles acute, apex not quite so suddenly or deeply sinuate as in the Neoholotype. Sides almost straight anteriorly, divergent, more rounding posteriorly, the basal angles strongly obtuse and broadly rounded. Sinuation at base within the angles very feeble. Coarsely and irregularly punctured in the usual positions, with minute punctules at the bottom of most of large punctures, the minute punctules sparse but evident. Transverse tubercles far forward, at about apical two-sevenths, medial rather long, low, acute each side of middle, feebly grooved behind this acute part. Medial groove sub-triangular rather than convex in cross section, moderately deep, not attaining base.

Elytra: As in Neoholotype, except that the minute punctules are scarcely discernible.

Neoholotype and Neoallotype: Medora, Kansas, 14.VII.23. Collected by Mr. Warren Knaus, and through his generosity in my collection.

Material examined: 15 specimens.

Localities: Kansas, Minnesota (Le Sueur Co., Fish Hatchery, At Light, R. W. Dawson, 15.VII.23), Louisana (Winnfield, 2.V.18) ex collection H. C. Fall.

The Louisiana specimen is an unarmed male and I am not absolutely sure that it is this species, but it is nearer to it than to any other.

Odontaeus simi sp. nov.

Odontaeus filicornis Blatchley nec. Say. (Coleoptera of Indiana, P. 938.).

Holotype: *Shape and Size*: Oblong-oval. Length: 7.49 mm. Width: 4.83 mm.

Colour: Dark yellowish brown above, antennae, femora and under side a little lighter, tibiae and tarsi about the colour of upper side.

Clypeus: Rounded at sides, feebly emarginate at middle, the angle formed by the meeting of the two halves of the clypeal margin very obtuse. Margin acute but scarcely as strong as in *filicornis*. Surface broken up into large moderately shallow depressions by irregularly intersecting rugosities; a few scattered fine punctules on rugosities. Medial carina more nearly continuous with the anterior margin as in *floridensis*, stronger throughout than in *filicornis*, rather markedly elevated at about middle of clypeus; not as long as in *filicornis*, about two-thirds clypeal depth. Horn movable, sparsely and finely punctate anteriorly and laterally.

Thorax: Anterior angles a little less than right, scarcely rounded. Apical width obviously a little more than greatest width of head, the apical angles well outside the free margin of the head at its termination at the eye. Apex less abruptly sinuate within than in *filicornis*. Sides moderately diverging anteriorly (though less so than in *filicornis*) less rapidly converging from about middle to base. Basal angles nearly right, moderately rounded. Sinuation of base within the basal angles more pronounced than in *filicornis*. Large punctures much as in *filicornis* but decidedly sparser—especially laterally—throughout.

Medial elevation moderately well forward, the tubercles at about apical five-eighths, deeply emarginate between them, tubercles a little more widely apart than in *filicornis*, groove wide and deep, extending further basally than in *filicornis*, sides of medial elevation much narrower and more acute than in *filicornis*, the punctures mostly crowded on the medial line. Lateral foveae deep, the greatest depth not so near the lateral ridges as in *filicornis*, moderately separated from base, and their anterior transverse bounding elevation less pronounced than in *filicornis*. Lateral ridges strong, thicker (transversely) than in *filicornis*, rounded, highest basally of the middle, sloping more steeply basally, and running well forward of the medial tubercle.

Elytra: Striae feebly impressed, a little more so basally. Strial punctures smaller than in *filicornis*, rounded, moderately deep, a little more widely spaced especially laterally than in *filicornis*. Minute punctules evident, eleventh stria fairly well developed, fourteenth moderately curved basally, its punctures smaller and shallower than in *filicornis*, the extra punctures in or near the gutter, fewer, smaller and more shallow.

Legs: Last joint and its claws of the hind tarsus are respectively a little shorter than those in *filicornis*. (See Figs. 17a, 17b, 18a, 18b.).

Genitalia: Outer lobes pale. Medial lobe a little darker especially basally in the "hook," nearly evenly curved though feebly sinuate above towards tip. A little longer than in *filicornis*. (See Fig. 8.).

Allotype: *Shape and Size*: Oblong-oval. Length 7.91 mm. Width: 4.90 mm. (The head is a little more exserted than usual, giving a somewhat greater length.).

Colour: As in holotype.

Clypeus: Depth from front to back as usual greater than in male but also proportionally deeper than in female *filicornis*. Anterior margin not very strong, acute. The shallow depressions among the rugosities larger than in female *filicornis* and with punctures. Medial carina longer, more pronounced throughout, more nearly continuing anterior margin caudad and more definitely elevated in the middle of clypeus than in female *filicornis*.

Thorax: Apex wider in proportion to head, basal angles less obtuse and less rounded, sinuation within the basal angles stronger, transverse ante-medial carina longer, stronger, more acute throughout, medial groove deeper and narrower with punctures more confined to medial line than in female *filicornis*.

Elytra: Striae and intervals much as in holotype, the punctures more widely spaced and the fourteenth stria a little more curved, and basally with less impressed, considerably smaller punctures than in female *filicornis*.

Legs: Claws of hind tarsi very evidently, last joint of hind tarsi a little shorter than in female *filicornis*.

Holotype: Merchantville, N. J. 27.VII.26.

Allotype: Merchantville, N.J., 2.VII.26.

Both collected by Mr. R. J. Sim, who has presented them to me and to whom as an acknowledgment of his great success in finding these elusive beetles, the species is dedicated.

***Material examined*: 146.**

Localities: Indiana, New York, New Hampshire, Connecticut, Massachusetts, New Jersey, Michigan.

This species is very close to *filicornis* Say and I have therefore made the description more or less of a comparative one with that species.

Floridensis, simi, and *filicornis,* from the close similarity of the genitalia of the males, form a natural group.

Floridensis should be recognized from its richer red-brown colour, its small size, peculiar clypeus, more widely spaced strial punctures of elytra, and other characters as given. The middle lobe of the genitalia is proportionally longer than in either of its two closely allied species. (See Figs. 6, 7, 8.).

The descriptions of *simi* were purposely drawn from specimens as nearly like *filicornis* as were among the magnificent series sent by Mr. Sim. The direction of variation, therefore, is away from each other as described. Thus the anterior thoracic angles in *simi* vary towards right, while *filicornis* varies towards acute. Similarly, the basal thoracic angles in *simi* vary towards right, with the basal sinuation of thorax deeper and even a faint sinuation of the posterior half of the thoracic sides, while in *filicornis* the tendency is towards more obtuse basal angles, less deep sinuation within these angles and a greater rounding of the thoracic sides. The greater width of the thoracic apex in proportion to the head, the finer and more widely spaced punctures of the elytral striae and the shorter hind tarsal claws and claw joints in *simi* appear to give characters which suffice to distinguish the two species.

Odontaeus cornigerus Melsh.

Bolbocerus cornigerus Melsh. Proceedings of the Academy of Natural Sciences of Philadelphia, Vol. II, 1844 and 1845.

Red-brown; head armed with a long filiform horn; thorax greatly unequal; elytra crenate-striate—5L, long, 3L. wide. Pennsylvania ? (1 sp.).

Scarabaeus cornigerus Melsh. M.S. Reddish-brown; head blackish, scabrous; clypeus rounded, marginate, with a short longitudinal raised line at tip, base armed with a filiform smooth curved horn; thorax very unequal, strongly carinate in the middle, the carina grooved towards the base for the occasional reception of the apical portion of the horn; each side of the carina with a wide and profound concavity, having its outer elevated narrow edge abbreviate a little behind the anterior margin; lateral edges reflexed; posterior angles obtusely rounded—anterior ones sub-acute; lateral margins and concavities sparsely and profoundly punctured; scutel sub-cordate, concave at base; obsoletely punctured; elytra crenate-striate, interstices convex, anterior tibiae quadri-dentate with the apical tooth widely crenate.

In Vol. III, Transactions Americal Entomological Society, in his resume of the Genus, Horn says of this species, "Similar in colour to the preceding (i.e. pale castaneous or ferruginous) but occasionally black. The horn is less slender than in *filicornis* and fixed. This species attains a somewhat larger size than the preceding and is usually more robust. Middle and Central States."

It appears certain that Dr. Horn was not familiar with the Melsheimer species. In the Academy of Natural Sciences at Philadelphia, eight specimens stood as *cornigerus* three of which were Dr. Horn's. The first of these three is a male of the species described hereinafter as *liebecki.* The second a female from New York probably *liebecki.* The third is a male with thoracic horns and

belongs to the species described above as *thoracicornis*. On the whole Dr. Horn seems to have considered the species with thoracic horns as *cornigerus*, for as stated previously, Mr. Charles Dury of Cincinnati, Ohio, sent me such a specimen so identified by Dr. Horn. From Dr. Horn's use of the words "occasionally black" in his comments quoted above, it seems probable that he mixed with the two species already mentioned a third, probably *falli*, as, so far as the material examined shows, no specimens of *liebecki*, *thoracicornis* or *cornigerus* are ever black.

That *cornigerus* is not the species with thoracic horns is at once evident from Melsheimer's words relating to the lateral edge of the "profound concavities" which he speaks of as "its outer elevated narrow edge." By no stretch of the imagination could this phrase be used to describe the conical thoracic horn of *thoracicornis*, and the thoracic concavities of that species do not have "outer elevated narrow edges."

It seemed very probable, however, that the species was the one relatively common in the East and East Central States, represented in Dr. Horn's material by the first specimen in his series. That fine coleopterist, Mr. Charles Liebeck of Philadelphia was strongly of this opinion. Fortunately, the type of *cornigerus* was found by Dr. H. C. Fall and Mr. P. J. Darlington, Jr. in the M.C.Z. at Cambridge, and I was much surprised on receiving a specimen compared with the type by Mr. Darlington to find that this homotype was not the species of the Horn collection. As the abdomen of the type had disappeared and consequently no genitalic comparison was possible, I sent specimens of the two species to Dr. Fall and he kindly again went to Cambridge and compared these with the type. He reported as follows: "Such small superficial differences as I detected in your two specimens appear very trifling—but I am able to declare with a good deal of positiveness that the Melsheimer type—if we may so call it—agrees in these respects with the Highlands N. C. example which Darlington selected to represent the species, and I haven't the slightest doubt it is specifically the same." (H. C. Fall in litt. 10.X.26).

Mr. Darlington, who made a very careful comparison between Melsheimer's specimen and the Highlands N. C. specimen mentioned above, and marked the latter "homotype," says that the "blackish-scabrous" head of the Melsheimer specimen is due to discolouration and dirt. So far as I know the head in *Odontaeus* is always practically concolorous with the rest of the upper surface.

Cornigerus Melsh. is one of our finest species, and the males can as a rule, apart from their size, be told from all our other species by their more parallel form. The more fully armed males and the females are less parallel resembling in shape several other species. The middle lobe of the male genitalia is apparently unique. (See Fig. 9.).

The species has not been taken commonly, the following localities being represented by ten specimens: North Carolina, Virginia, Maryland, New Jersey, Georgia, New York.

Odontaeus liebecki sp. nov.

Holotype: *Shape and Size*: Oblong-oval, somewhat more parallel than usual in the genus. Convex as usual. Length: 9.31 mm. Width: 6.16 mm.

Colour: Dark red-brown above, somewhat lighter below, femora colour of under side, tibiae and tarsi, of upper; Antennal club, especially outer joints, yellowish brown, basal joints of antennae dark. Shining.

Clypeus: Almost evenly rounded though very slightly sub-angulate at sides; acutely margined, quite densely and coarsely punctured, slightly rugose with very fine punctules on spaces between large punctures. Slightly swollen a little anteriorly of middle on median line, very feebly carinate or elevated along this swelling. Horn fixed, rather finely and sparsely punctate.

Thorax: Anterior angles about right, slightly rounded, apex rather deeply sinuate. Sides rapidly divergent from apical angles and nearly straight for about half depth of thorax, thence almost parallel though feebly sinuate to posterior angles, which are rounded and about right. Base distinctly sinuate. Not densely punctured though moderately so on sides. Minute punctules visible only on close examination with high power. Medial elevation short, at about basal three-eighths, rather narrow anteriorly rapidly widening basally, triangularly open at front with the tubercles prominent and obliquely longitudinal, the groove moderately deep in front, very shallow behind. Lateral foveae deep and large, deepest well within basal third, separated quite narrowly from basal margin by the inwardly inflexed edge of the lateral ridges. Lateral ridges prominent, rounded throughout but more gradually in front, the highest point being behind the medial tubercles.

Elytra: Striae moderately deep, as usual less so externally. Punctures round and moderately deep, slightly larger externally, smaller apically, separated throughout by about their own diameters. Intervals moderately convex, with extremely fine and very sparsely distributed punctules. Eleventh stria well developed. Fourteenth curving well away from margin basally.

Genitalia: Outer lobes pale yellow, middle lobe very little darker, flattened in the vertical plane, short for the group, very little upturned at tip. (See Fig. 10).

Allotype: *Shape and Size*: Almost exactly as in holotype. Length: 9.80 mm. Width: 6.16 mm. the difference in length apparently being due to the more extended position of the head of the allotype.

Colour: As in holotype.

Clypeus: As in holotype except that the faint medial elevation does not reach quite so far back.

Thorax: Anterior angles a little less than right. Anterior half of sides not quite so divergent from apical angles and posterior half a trifle more convergent towards basal angles than in holotype, with the sinuation even less evident. Basal angles rounded and right. Base obviously sinuate. A moderately short transverse ridge at about apical third with a slight tubercle at each end narrowly and shallowly separated, and a little more anteriorly placed. A slight depression posterior to the transverse ridge and a medial narrow shallow groove. Puncturation moderately coarse and close, the elevations as usual impunctate except for the minute sparse punctules visible throughout.

Elytra: As in holotype.

Holotype and Allotype: Cornwall, Ct., 30.V.21. Taken under wash-up by Mr. K. F. Chamberlain, who has kindly permitted me to retain the specimens.

Specimens examined: 96.

Localities: Ontario, New York, New Jersey, New Hampshire, Massachusetts, Maryland, Michigan, North Carolina, Long Island, Maine, Vermont, Delaware, Virginia, Indiana, Connecticut, Missouri.

The great majority of the specimens come from the Eastern States.

This is the species that frequently appears in collections as *cornigerus* and indeed it is very much like that species. The medial thoracic elevation is usually narrower and its groove deeper in *cornigerus*. The apical thoracic angle in *cornigerus* is more obtuse and the apex of the thorax less sinuate than in *liebecki*. Well developed males of *cornigerus* are distinctly narrower and more parallel in proportion to their size though obviously larger than in *liebecki*.. The colour when mature is prevalently darker in *liebecki*. The middle lobe of the male genitalia is quite distinctive.

Mr. R. J. Sim records taking *liebecki* in burrows under a layer of humus in yellow clay containing pebbles and rocks.

This species is named in honour of the well-known coleopterist Mr. Chas. Liebeck.

Odontaeus darlingtoni sp. nov.

Holotype: *Shape and Size*: Oblong-oval. Maximum width a little in front of middle. Length: 8.19 mm. Width: 5.32 mm.

Colour: Dark red-brown above, a little lighter below. Antennae, tibiae and tarsi about concolorous with the upper, femora with the under side. Moderately shining.

Clypeus: Rather narrow from back to front, broadly rounded, acutely and strongly margined, strongly rugose rather than punctured. Finely but distinctly carinate for three-quarters of depth, the carina being elevated at middle of clypeus. Horn movable, sub-parallel for most of its length, slightly swollen towards apex; apex distinctly excavated below, front face finely and sparsely punctate.

Thorax: Anterior angles about right, scarcely rounded, apex not very abruptly sinuate. Sides rapidly divergent for about two-fifths of length, thence almost parallel though very slightly convergent to posterior angles. Posterior angle a little more than right, base of thorax not deeply sinuate within. Not closely or densely punctured, the elevations smooth except for an exceedingly minute system of scattered punctules. Medial elevation well forward at about apical third, rather narrow, closed in front and not tuberculate, its sides diverging only a little basally, central groove broad and shallow. Lateral foveae deep and large, somewhat transverse so that they are well separated from the thoracic base, and their greatest depth is not much posterior to the middle of thorax. Lateral ridges prominent, rounded from back to front though more gradually in front, the highest point being at about opposite the middle of the medial elevation.

Elytra: Striae not deep, the sutural the most so, the outer ones scarcely at all impressed. Strial punctures rounded, deep, well separated—on most of the striae by more than their own diameters—not much different in size apically or laterally. Intervals but very slightly convex, the minute punctules scarcely distinguishable. Eleventh stria considerably abbreviated in front, fourteenth well curved away from margin basally.

Genitalia: Outer lobes pale yellow, middle lobe pale brown, "hook" very short and narrow, "shank" gradually narrowed, feebly sinuate above, more strongly bisinuate beneath. (See Fig. 11).

Allotype: *Shape and Size*: Almost exactly as in holotype.

Colour: Red-brown—a little paler than the holotype, distribution of colour the same.

Clypeus: Deeper than in holotype, sculpture the same, except that medial carina is shorter and less elevated at middle of clypeus.

Thorax: Allowing for sexual differences shape as in holotype. The transverse ridge rather short, at about apical third, the lateral tubercles well separated from ridge but rather poorly developed. The medial depression narrow, deep, and coarsely and confluently punctured. The usual puncturation rather coarse, deep and close. The elevations with an obvious system of finer punctules which are larger anteriorly.

Elytra: Striae deeper and intervals more convex, strial punctures closer than in holotype.

Holotype and Allotype: Rancocas Park, N.J., 27.X.26, both taken by Mr. R. J. Sim, who has presented them to me.

Specimens examined: 125.

Localities: Virginia, New Jersey, North Carolina, D. C., Massachusetts, New York.

Found commonly by Mr. R. J. Sim in Pine Barrens in New Jersey working in yellow sand beneath a layer of humus. The species must be fairly common at Southern Pines, N C. as a number were collected there by the Rev. A. H. Manee.

Dedicated to Mr. P. J. Darlington in recognition of his assistance in the preparation of this paper.

EXPLANATION OF PLATE.

(All figures greatly enlarged.).

Figure 1. Fixed horn type in *Odontaeus*. (a. Suture).
Figure 2. Movable horn type in *Odontaeus*. (a. Suture. b. Depressed area behind attachment of the horn.).
Figure 3. Middle lobe of genitalia of *O. obesus* Lec.
Figure 4. Middle lobe of genitalia of *O. falli* sp. nov.
Figure 5. Middle lobe of genitalia of *O. thoracicornis* sp. nov.
Figure 6. Middle lobe of genitalia of *O. floridensis* sp. nov.
Figure 7. Middle lobe of genitalia of *O. filicornis* Say.
Figure 8. Middle lobe of genitalia of *O. simi* sp. nov.
Figure 9. Middle lobe of genitalia of *O. corniger*us Melsh.
Figure 10. Middle lobe of genitalia of *O. liebecki* sp. nov.
Figure 11. Middle lobe of genitalia of *O. darlingtoni* sp. nov.
Figure 12. Margin of clypeus of *O. floridensis* sp. nov. showing the deep emargination.
Figure 13a, 13b. Part of head and thorax of *O. filicornis* Say. (a) ♂ (b) ♀ showing close approximation of anterior thoracic angle to margin of head.
Figure 14a, 14b. Part of head and thorax of *O. simi* sp. nov. (a) ♂, (b) ♀, showing the separation between the anterior thoracic angle and the margin of the head.
Figure 15. Base of thorax of *O. filicornis* Say showing basal angle and the sinuation within.
Figure 16. Base of thorax of *O. simi* sp. nov. showing basal angle and the sinuation within.
Figure 17a, 17b. Last posterior tarsal joint and claw of *O. filicornis* Say (a) ♂, (b) ♀.
Figure 18a, 18b. Last posterior tarsal joint and claw of *O. simi* sp. nov. (a) ♂, (b) ♀.

KEY TO THE SPECIES OF HADRONEMA UHLER WITH DESCRIPTIONS OF FIVE NEW SPECIES (HEMIPTERA, MIRIDAE).*

BY HARRY H. KNIGHT,
Ames, Iowa.

In working up considerable material which the writer collected in the western United States certain new species of *Hadronema* have been recognized, with the result that a key is provided for the thirteen known species of which five are described as new. In 1918, Mr. E. H. Gibson published a key (Can. Ent., xl, pp. 81-84) to the species known to him, describing two new species. The writer examined these types in the U. S. National Museum during 1926 and found that *Hadronema confraterna* Gib. is in fact a good species of *Lopidea*, allied to *Lopidea lepidii* Kngt., but smaller and the left clasper somewhat differently shaped.

Since the appearance of Gibson's paper Mr. Van Duzee has described two species from California, *Hadronema albescens* and *H. infans*. Paratypes of these are at hand for the present study and one of them, *Hadronema infans*, I find belongs in the genus *Lopidea*, in fact I am unable to distinguish between this and *Lopidea minima* Kngt. In *Lopidea* the form of the left clasper is distinctive throughout the large number of known species and on this basis as well as color, *confraterna* Gib. and *infans* Van D. belong in *Lopidea*.

The male genital characters in *Hadronema* are on the whole distinctive of the genus and displaying only minor differences between the species. The genotype, *Hadronema militaris* Uhler, exhibits an unusual character in the cleft nature of the genital segment at base of left clasper, while the right clasper is in general form much like other species of the genus. In *militaris* and allied species the male is provided with a secondary sexual character in the form of a heavy tubercle, bearing one or two spines and situated at base of front femora on lower side; also the basal segment of front tarsi is bilobed and widely expanded. On the basis of these characters, as well as the type of pubescence, the genus may be separated into two groups. The typical subgenus includes *militaris* Uhler, *picta* Uhler, *breviata* n. sp., *simplex* n. sp., *bispinosa* n. sp., *sinuata* n. sp., and probably *splendida* Gibson. The remaining species, *princeps* Uhler, *uhleri* Van D., *uniformis* n. sp., *festiva* Van D., *decorata* Uhler, and *albescens* Van D., are without the secondary sexual characters and form a group of species for which a new subgeneric name is proposed:

AOPLONEMA, new subgenus. Genotype: *Hadronema princeps* Uhler.

In preparing the key all the known species are at hand except *decorata* Uhler and *splendida* Gibson. Types of *decorata* Uhler are preserved in the collection of the California Academy of Sciences where I saw them in 1917. However, for separating this species in the key it has been necessary to draw on the color characters given in the original description.

Hadronema breviata new species

Allied to *picta* Uhler, but distinguished by the short second antennal segment which is not equal to width of head across eyes; rostrum longer, pronotal disk dark except at basal angles.

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*Contribution from the Department of Zoology and Entomology, Iowa State College, Ames Iowa.

♂. Length 2.9 mm., width .98 mm. Head: width .75mm., vertex .40 mm. Rostrum, length .80 mm., extending to middle of intermediate coxae. Antennae: segment I. .22 mm.; II, .68 mm., not equal to width of head across eyes; III, missing. Pronotum: length .47 mm., width at base .86 mm.; calli more convex, also more depressed between and along front margins of calli than in *picta*.

Dorsum clothed with finer, fuscous pubescence than in *picta*. Black, opaque, surface covered with a dull bluish-gray bloom; pronotum with basal angles and posterior one-third of propleura pale, embolium and outer half of cuneus white. Front femora with a prominent spur at base on ventral surface much as in *picta*, but the right genital clasper is distinctly more slender.

♀. Length 2.8 mm., width 1 mm. Head: width .75 mm., vertex .44 mm. Rostrum reaching to near posterior margins of intermediate coxae. Antennae: segment I, length .19 mm.: II, .62 mm.; III, .53 mm.; IV, .29 mm. Pronotum: length .48 mm., width at base .93 mm. Coloration and pubescence very similar to the male.

Holotype: ♂ July 20-25, 1920, Yellowstone National Park, Wyoming (A. A. Nichol); author's collection.

Allotype: July 1927, Kaibab Forest, rim Grand Canyon, Utah (Vasco M. Tanner).

Paratypes: ♀, taken with the allotype. 4 ♀ Aug. 25, 1926, Kaibab Point, Arizona (A. A. Nichol). ♀, Orderville, Utah (Vasco M. Tanner).

Hadronema simplex new species.

Suggestive of a small form of *militaris* Uhler, but the male genital segment not cleft while the claspers are more like those of *picta* Uhler; antennal segment III not equal to width of head.

♂. Length 3.2 mm., width 1.1 mm. Head: width .81 mm., vertex .45 mm. Rostrum, length .90 mm., reaching between middle coxae. Antennae: segment I, length .26 mm.; II, .89 mm., nearly equal to thickness of segment I, but more slender near base; III, .78 mm.; IV, .44 mm. Pronotum: length .53 mm., width at base .92 mm.; calli less prominent than in *militaris*, disk depressed about their margins.

Dorsum clothed with longer but more sparsely set black hairs than in *militaris*. Coloration very similar to *militaris;* black, posterior half of propleura and more or less on basal angles of disk, reddish or orange colored; embolium, outer basal half of corium, and cuneus except inner margin, white. Front femora with a single strongly developed tuberculate spine on ventral side at base, with a curved claw-like tip and beneath this a smaller curved spine, outer surface of tubercle set with three or four strong bristles. Front tarsus with basal segment strongly dilated, concave beneath, which is also true of the male *militaris*. Genital segment not cleft at base of left clasper which feature is distinctive of *militaris;* claspers slender and only slightly different from those of *picta*.

♀. Length 3.8 mm., width 1.35 mm. Head: width .89 mm., vertex .52 mm. Antennae: segment I, length .27 mm.; II, .95 mm.; III, .78 mm.; IV, .44 mm. Pronotum: length .65 mm., width at base 1.12 mm. More robust than the male but very similar in pubescence and coloration.

Holotype: ♂ August 8, 1927, Yellowstone National Park, Wyoming (H. H. Knight); author's collection.

Allotype: same data as type.

Paratypes: 3 ♂ 2 ♀, taken with the types by sweeping mixed herbage along the roadside between Roosevelt Lodge and Mammoth Hot Springs, on the high, treeless, plateau area. ♀ June-Aug. 1907, Cheyenne, Wyoming (Fanny T. Hartman). ♂, Lethbridge, Alberta (W. Carter).

Hadronema bispinosa new species.

Allied to *picta* Uhler, but distinguished in the male by two strongly developed spines situated at the base of front femora on ventral surface; also differs in the paler color, longer second antennal segment, with femora yellow and marked with blackish.

♂. Length 3.4 mm., width 1.1 mm. Head: width .80 mm., vertex .44 mm.; white to yellowish, tylus, two broad arcuate rays each side of frons and joining at base to include carina and collum, black. Rostrum, length .89 mm.; reaching upon base of middle coxae, white, apical half blackish. Antennae: segment I, length .28 mm.; II, .89 mm; III, .83 mm.; IV, .37 mm.; black. Pronotum: length .63 mm., width at base .98 mm.

Dorsum clothed with prominent black hairs much as in *picta*. Coloration yellowish to white, calli, spot at top of coxal cleft, base of scutellum more or less, clavus, apical area of corium, inner basal angle of cuneus, and sternum, black. Membrane fuscous, veins and anal area black. Coxae yellowish to white, with black at base; femora yellowish to orange colored, spotted near base, front pair with linear row of spots before and behind, hind pair with blackish apically; hind tibiae black, front pair orange except tip. Front femora strongly swollen, projecting at base on ventral surface and provided with two prominent, slightly curved spines.

♀. Length 3.7 mm., width 1.4 mm. Head: width .87 mm., vertex .50 mm. Rostrum, length 1 mm., reaching to base of middle coxae. Antennae: segment I, length .28 mm.; II, .93 mm.; III, .81 mm.; IV, .40 mm. Pronotum: length .66 mm., width at base 1.18 mm.

Holotypes ♂ July 31, 1927, Moorecroft, Wyoming (H. H. Knight); author's collection.

Allotype: same data as the type.

Paratypes: 66 ♂ ♀, taken with the types on *Petalostemum multiflorum* Nutt., which was the host plant of the species. WYOMING—20 ♂ ♀ July 20, Sundance; ♂ Aug. 1, Kendrick; 22 ♂ ♀ Aug. 3, Sheridan; 15 ♂ ♀ Aug. 16, 1927, Greybull (H. H. Knight). COLORADO—♀ June 29, 1901, Fort Collins. SOUTH DAKOTA—♂ 2 ♀ July 29, 1927, Deadwood (H. H. Knight).

Hadronema sinuata new species.

Suggestive of *splendida* Gibson, but distinguished by the strongly sinuate margins of pronotum, also by the different coloration.

♀. Length 3.8 mm., width 1.3 mm. Head: width .90 mm., vertex .53 mm.; vertex and frons tumid, carina strongly developed, set with six bristles, deeply impressed bordering its front edge: orange colored, tylus except base and side margins, spot on apex of lora, broadly on frons except median line, extending back over vertex to carina and collum, blackish. Rostrum, length 1.05 m.m., just attaining hind margin of sternum, blackish, first two segments orange to pale. Antennae: segment I, length .25 mm.; II, .86 mm.; III, .81 mm.; IV, .41 mm.;

black. Pronotum: length .68 mm., width at base 1.14 mm.; disk with lateral margins strongly sulcate-sinuate, basal margins distinctly sinuate at middle; orange colored, basal margin rather broadly and the collar, white, calli and spot at top of coxal cleft black. Scutellum blackish although a tinge of orange shows through the dark color.

Hemelytra blackish, embolium and invading corium, basal angle of corium, and cuneus except narrow inner margin, white; membrane fuscous, veins and within areoles somewhat darker. Dorsum clothed with stiff, erect black hairs, venter with pale pubescence. Ventral surface fuscous, covered with a dull bloom, venter with distal half of each segment pale; sheath of ovipositor tinged with orange. Legs orange yellow, coxae dark at base, femora with obsolete fuscous spots and points, hind pair becoming infuscated on apical half; tibiae blackish, front pair showing orange, tarsi black.

Holotype: ♀ June 24, 1925, alt. 7000 ft., Williams, Arizona (A. A. Nichol); author's collection.

Hadronema (Aoplonema) uniformis new species.

Allied to *princeps* Uhler, but differs in the uniformly black cuneus and orange yellow femora; differs from *uhleri* Van D. in the larger head with more tumid frons, also the median line between calli not impressed.

♂. Length 4 mm., width 1.2 mm. Head: width .93 mm., vertex .44 mm. Rostrum, length 1.63 mm., nearly reaching posterior margins of hind coxae. Antennae: segment I, length .41 mm.; II, 1.5 mm.; III, 1.26 mm.; IV, broken. Pronotum: length .68 mm., width at base 1 mm.; form nearly as in *princeps*.

Black, the cuneus uniformly colored with the corium; femora uniformly orange yellow, pronotum behind calli and the scutellum orange yellow in the hypodermis but more or less obscured by fuscous in the cuticula; juga, lora, first segment of rostrum, and coxae, orange yellow. Clothed with simple pale pubescence and intermixed with shorter, finer and somewhat sericeous pubescence.

♀. Length 4.2 mm., width 1.45 mm. Head: width 1.02 mm., vertex .53 mm. Antennae: segment I, length .35 mm.; II, 1.3 mm.; III, 1.09 mm.; IV, broken. Pronotum: length .78 mm., width at base 1.24 mm. More robust than the male but very similar in pubescence and coloration.

Holotype: ♂ June 16, 1926, Vale, Oregon (R. W. Haegele); author's collection.

Allotype: same data as the type; taken by Mr. Haegele on greasewood (*Sarcobates vermiculatus*) which apparently is the host plant.

Paratypes: ♀ June 16, 1926, Nyssa, Oregon (R. W. Haegele), taken on greasewood. ♂ June 15, 1926, Caldwell, Idaho (R. E. Haegele), taken on greasewood.

KEY TO SPECIES OF HADRONEMA

1. Antennal segment III distinctly shorter than segment II ..... 3.
   Antennal segment III equal to or longer than segment II ..... 2.
2. Pubescence pale, pronotum fuscous, embolium and outer margin of corium orange colored .... *festiva* V. D.
   Pubescence black, pronotum except calli reddish ..... *picta* Uhl.

3. Embolium and more or less on outer margin of corium and cuneus, pale or whitish ..... 4.
Embolium and outer margin of corium and cuneus not whitish, sometimes the embolium with pale but its outer edge always blackish ..... 11.
4. Pubescence pale, rather fine ..... 5.
Pubescence black, rather stiff ..... 6.
5. Hemelytra dull black, costal margin narrowly yellowish, inner edge of clavus, a wider line running diagonally back to inner angle of corium, bluish white ..... *decorata* Uhl.
Hemelytra white to lead-colored, a blackish spot on inner angle of corium ..... *albescens* V. D.
6. Femora black ..... 7.
Femora chiefly yellowish to reddish ..... 9.
7. Antennal segment II in length exceeding width of head across eyes ..... 8.
Antennal segment II not equal to width of head; pronotum dark, with dull bluish-gray bloom; small, length 2.8-3 mm. ..... *breviata* n. sp.
8. Antennal segment III in length greater than width of head; male genital segment deeply cleft at base of left clasper ..... *militaris* Uhl.
Antennal segment III not equal to width of head; male genital segment not cleft ..... *simplex* n. sp.
9. Pronotum with lateral margins strongly sinuate-sulcate, basal margin sinuate at middle; disk orange except calli, basal margin whitish .... *sinuata* n. sp.
Pronotum not distinctly sinuate at sides or base ..... 10.
10. Pronotum black or gray, without pale or reddish; lower face chiefly black ..... *splendida* Gib.
Pronotum pale to yellowish, calli only black; lower face except tylus, yellowish to whitish; male with two prominent spurs on base of front femora ..... *bispinosa* n. sp.
11. Cuneus uniformly black like the corium ..... 12.
Cuneus pale or reddish on base; female frequently with pale along claval suture ..... *princeps* Uhl.
12. Femora red; median line between calli and forward to collar distintly impressed ..... *uhleri* Van D.
Femora uniformly orange yellow; median line between calli not impressed ..... *uniformis* n. sp.

Records of distribution for the species of Hadronema are not extensive, hence the following data seems worth the printing.

Hadronema militaris Uhler. Records: COLORADO—Stonewall, near Trinidad, Aug. 7; Veta Pass, Aug. 9; Wolf Creek Pass, Aug 12, Ute Creek. Fort Garland, Aug. 11; Dolores, Aug. 15, 1925 (H. H. Knight). MONTANA—Missoula, Aug. 1, 1920 (A. A. Nichol). Big Fork, June 16, 1904; Bridger Canyon, July 12, 1902; Copperopolis, July 23, 1902; Florence, June 24, 1912; Sidney, June 14, 1912 (Mont. Agr. Expt. Station collectors). IDAHO—Ashton, Aug. 2, 1921 (F. M. Sallee). Stanley, July 10, 1926 (R. W. Haegele). INDIANA—Hessville, May 29, 1910 (W. J. Gerhard). SOUTH DAKOTA—Custer, July 27; Deadwood, July 29, 1927 (H. H. Knight). WYOMING—Yellowstone National Park, July 20-25, 1920 (A. A. Nichol); same, Aug. 8, 1927 (H. H. Knight). Shoshone National For-

est, Aug. 14; Big Horn Mts., Aug. 17, 1927 (H. H. Knight). ALBERTA—Armena, Aug. 27, 1920 (C. E. Hendrickson). Medicine Hat., June, 1912 (F. S. Carr).

Hadronema picta Uhler. Records: ARIZONA—Williams, June 24, 1925 (A. A. Nichol), "on *Hymenoxys floribunda.*" KANSAS—Riley County, Aug. 28 (G. A. Dean). Seward County, June 27 (Lantz). NEW MEXICO—Jemez Springs, Aug. 7, 1915 (J. Woodgate).

Hadronema princeps Uhler. Records: COLORADO—Golden, July 25, 1909 (W. J. Gerhard. Dolores, Aug. 15, 1925 (H. H. Knight). Fort Collins, July 9, 1902. Lookout Mt., July 28, 1916 (A. C. Burrill). IDAHO—Council, June 25, 1926 (R. W. Haegele). MONTANA—Beaver Creek, Aug. 1913, alt. 6300 ft. (H. B. Hungerford). Bridger Mts., Aug. 10, 1915, alt. 5500 ft. East Flathead, July 25, 1902 (Mont. Agr. Exp. Sta.). Missoula, July 31, 1920 (A. A. Nichol). OREGON —La Grande, June 26, 1926 (E. W. Davis.) WASHINGTON—Toppenish, June 12, 1926 (E. W. Davis). WYOMING—Shoshone National Forest, Aug. 14, 1927 (H. H. Knight), a good series swept from mixed herbaceous growth. Sundance, July 30; Yellowstone National Park, Aug. 8; Big Horn Mts., Aug. 17, 1927 (H. H. Knight).

Hadronema uhleri Van D. Records: ARIZONA—Grand View, Grand Canyon, Aug. 3, 1917 (H. H. Knight), on *Cowania mexicana.* Williams, June 24, 1925, alt. 7000 ft. (A. A. Nichol).

Hadronema festiva Van D. Mr. A. A. Nichol took a good series at Tombstone, ARIZONA, June 2, 1926, alt. 4500 ft.

"Van Duzee has just recently shown (Pan-Pacific Ent., IV, 1928, p. 182) that *Hadronema robusta* Uhler (1894) belongs in the genus *Lopidea,* while the *robusta* of later authors is described as a new species, *Hadronema uhleri* Van Duzee."

Mailed Monday, July 30th, 1928.